

averaged about 4.5 degrees per day below the normal for the 400 days prior to June 1, 1917, while for the 5 months from January to May, 1917, the average deficiency was about 7 degrees per day. From January 8 to 26, 1917, a period of 19 days, the mean daily temperature at Winnemucca was only 5.3° F., or 23 degrees per day below the normal. The temperature departures from the normal for different sections of the country from January to May, 1917, inclusive, are shown in figure 3.

Subnormal temperatures persisted in all or portions of Montana also during 8 months of 1916 and for each of the 5 months from January to May, 1917. The temperature in the northern portion of that State for the 17 months January, 1916, to May, 1917, inclusive, averaged 4 degrees per day below the normal. At times during this period Montana experienced extremely low temperatures. From January 2 to February 12, 1916, a period of 42 days, the daily mean at Havre was about -12°F., or 26 degrees per day below the normal. During December of the same year there was another, but shorter, period of extremely cold weather recorded at this station when for 11 days the temperature averaged -14°F., or 32 degrees per day below the normal.

Lowest mean May temperatures.

Figure 4 shows the years in which the lowest mean May temperatures of record occurred and the areas affected, as revealed by records for about 45 years. It will be noted by referring to this chart that 1917 had the lowest mean May temperatures of record for a larger area than any other year in which low records were established in this month. The area covered in 1917 embraces practically the whole of the New England, Atlantic, and Gulf States, the eastern Lakes Region, Ohio Valley, Tennessee, and the middle Mississippi Valley. Likewise the middle and southern Rocky Mountains region, Arizona, portions of Utah, Nevada, and California had, on the whole, the coldest May since extensive temperature records have been maintained.

The year 1907 was that in which the lowest mean May temperatures of record occurred over the next largest area. The low records established in May of that year, cover much of Texas, Oklahoma, Arkansas and Missouri, the upper Mississippi Valley, and also most of the Lake region and the northern border States westward to Montana. However, in considerable portions of the area in which low May records were established in 1917, the monthly means were only slightly lower than those recorded in 1907.

In sections of the country in which the lowest mean May temperature occurred in years other than 1907 and 1917, the areas affected in individual years were comparatively small and the cool conditions were more largely the result of local causes. In most of South Dakota, in Nebraska, and in the northern portion of Kansas, the lowest mean May temperatures of record occurred in 1892, while in much of the northern Rocky Mountain and central and northern Plateau districts the lowest records were made in 1896 or 1899.

COLD WEATHER IN EUROPE DURING THE WINTER AND EARLY SPRING OF 1917.

While temperature conditions in the United States east of the Rocky Mountains, during the past winter and up to and including the most of April were not unusual, reports from Europe indicate that this period was characterized by severely cold weather and heavy snowfall.

Unseasonably cold weather is reported to have set in over Europe toward the close of November, 1916, and continued till near the close of April, 1917. In London the temperature for the five months, December, 1916, to April, 1917, inclusive, averaged nearly 4 degrees below the normal, this being very unusual for a place whose climate is largely of the marine type. Information from western and northern Europe indicates that the continent was similarly affected with prolonged cold. However, about the time the period of cold weather set in over the central and eastern portions of the United States, the last decade in April, the persistent cold in Europe gave way to much warmer weather, and the month of May was rather remarkable for unseasonably high temperatures.¹

OTHER COLD SPRINGS.

With respect to cold springs and summers, the year 1816 stands out as the most memorable for persistent cold weather and damage to vegetation, not only in this country, but in most of Europe also. This is known in the United States as "the year without a summer," and in Europe as "the famine year." From the information at hand there is no doubt that the year 1816 was a most disastrous one for agricultural interests. In it there culminated a remarkable depression of summer temperatures which began with the summer of 1811 and continued till 1817. In portions of the Central and Northern States snow or frost appears to have occurred in every month of 1812 and 1816, and well-authenticated reports of loss of life by cold in the summer of the latter year are on record. Fruits and grains, especially corn, either partially or wholly failed to mature, resulting in a scarcity of food not known since that time.

The year 1859 was also remarkable for the cold weather experienced during the late spring or early summer. In that year, about June 5, severe cold weather for the season occurred in the Middle and North Atlantic States and Ohio Valley, temperatures several degrees below freezing being reported from many places, and freezing weather was general in western Pennsylvania and northern Ohio. Ice 2 inches thick was reported from Johnstown, Pa.

In 1882 May was remarkably cold for the season in the districts east of the Rocky Mountains, the mean temperatures for that month at many places being only 1 or 2 degrees higher than the lowest of record for May.

May, 1907, stands next to 1917 as a month of unusual cold, as has been noted previously, but despite the low temperatures staple crops were not materially reduced in yield. Likewise in May, 1910, there was a general and large deficiency in temperature in central and eastern districts.

SOME ASPECTS OF THE COLD PERIOD, DECEMBER, 1916, TO APRIL, 1917.

[Nature, London, June 28, 1917, 99: 359.]

R. C. Mossman presented, at the June 20 meeting of the Royal Meteorological Society, remarks on this subject. In the course of his remarks the author said that the mean temperature of the British Isles during the period under notice, taking the means of the 12 divisions used in the Monthly Weather Reports of the Meteorological Office, was 1.9 degrees C. below normal, the extremes ranging from 2.8 degrees below normal at

¹ In this connection see following abstract of address by R. C. Mossman as published in Nature, June 28, 1917.—Editor.

Belvoir Castle in Leicestershire and 2.7 degrees below at Newquay, up to only 0.5 degree below normal at Castle Bay in the Hebrides. Except in December, the cold was general over western Europe with the mean temperature of Sweden 1.9 degrees below, of Holland 2.7 degrees below, and of Norway 1.5 degrees below their respective normals; while as far south as Gibraltar the mean was 1.1 degrees below the average. It was shown that when the eastern portions of the British Isles had a mean temperature below the normal in each month from December to April—an event that had occurred only five times during the last century and a half—there was then a pronounced tendency for the depression of temperature to continue without interruption until the end of the year. The only exception occurred in 1808, when a warm period covering the four months from May to August was sandwiched in between two cold spells. The frequent absence of historic frosts during long periods of uniform cold over the British Isles was also referred to.

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ACCIDENTAL PRESSURE VARIATIONS IN THE UNITED STATES.

By ALFRED J. HENRY, Professor of Meteorology.

[Dated: Weather Bureau, Washington, D. C., July 6, 1917.]

A recent article by Dr. A. Defant on the daily, non-periodic pressure variations in the United States¹ recalls to my mind some work on the same subject on which I was engaged about 12 years ago. This work was undertaken at the suggestion of the late Professor Abbe, who at that time was in correspondence with the Russian meteorologist Woeikof [Voeikov] on the subject of the mean pressure variation in 24 hours. Press of other work prevented the completion of the study as originally planned, and the matter was laid aside for the time. The conclusions reached coincide quite closely with those announced by Dr. Defant, who has considered the mean hourly values as printed in the Annual Reports of the Chief of the U. S. Weather Bureau for 1898 to 1902 (4th edition).

It is convenient to think of the nonperiodic or accidental pressure fluctuations as advancing wavelike from west to east and as standing in close relation to the problem of weather forecasting, hence the very great interest of forecasters in the subject.

It has been known in a general way for many years that the changeable character of the weather on this continent is closely related to areas of rising and falling pressure that move at irregular intervals across the country from west to east. It has occurred to the writer that an examination of these waves of rising and falling pressure might lead to some interesting, if not valuable, results. There are several ways of attacking the problem, depending on the particular object in view.

Both the duration and amplitude of waves of rising or falling pressure can be obtained directly from the barograms, but since this method involves the measurement of a great number of instrumental records, a less precise plan was adopted, viz, that of taking the difference between the 8 a. m. "station pressure"² of one day as compared with that of the succeeding day at the

same hour, and affixing the proper algebraic sign. This has been done for a period of ten years, 1894–1903, for two stations on the Pacific coast, Portland, Oreg., and San Diego, Cal.; three stations in the Mississippi Valley, St. Paul, St. Louis, and New Orleans; and two stations on the Atlantic coast, Eastport and Key West. The record covers 3,650 days at each station, and shows in detail whether pressure was rising or falling and the amount of the change.

Number of periods of falling pressure and average interval.—The total number of periods of falling pressure for the several months of the year is given in Table 1. If the total number of periods of falling pressure of whatever length be divided into the number of days in the period, the average interval between two successive periods will be found. These data also appear in the table. The geographic coordinates of the stations are as follows:

	Lat. N.	Long. W.
Portland, Oreg.	45° 32'	122° 43'
San Diego, Cal.	32 43	117 10
St. Paul, Minn.	44 58	93 03
St. Louis, Mo.	38 38	90 12
New Orleans, La.	29 58	90 04
Eastport, Me.	44 54	68 59
Key West, Fla.	24 33	81 48

TABLE 1.—Total number of areas of falling pressure (katallobars),* and average time interval between them, in the 10 years 1894–1903.

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average, annual.
<i>Pacific coast.</i>													
Total number:													
Portland, Oreg.	81	83	80	74	78	75	70	85	72	75	82	80	93
San Diego, Cal.	77	66	75	74	72	72	70	72	67	72	71	74	86
Average interval (days):													
Portland, Oreg.	3.8	3.4	3.9	4.1	4.0	4.0	4.4	3.7	4.2	4.1	3.7	3.9	3.9
San Diego, Cal.	4.0	4.3	4.1	4.0	4.3	4.2	4.4	4.3	4.5	4.3	4.2	4.2	4.2
<i>Mississippi Valley.</i>													
Total number:													
St. Paul, Minn.	92	69	80	73	77	70	76	87	80	79	83	82	95
St. Louis, Mo.	88	71	73	71	79	63	70	73	70	73	78	83	80
New Orleans, La.	75	72	70	69	66	64	64	75	67	68	74	75	84
Average interval (days):													
St. Paul, Minn.	3.4	4.1	3.9	4.1	4.0	4.3	4.1	3.6	3.8	3.9	3.6	3.8	3.8
St. Louis, Mo.	3.5	4.0	4.3	4.2	3.9	4.8	4.4	4.3	4.3	4.3	3.8	3.7	4.1
New Orleans, La.	4.1	3.9	4.4	4.3	4.7	4.7	4.8	4.1	4.5	4.6	4.1	4.1	4.3
<i>Atlantic coast.</i>													
Total number:													
Eastport, Me.	88	75	70	75	77	70	72	80	80	84	82	86	95
Key West, Fla.	70	68	65	60	56	64	66	64	50	58	59	62	75
Average interval (days):													
Eastport, Me.	3.5	3.8	4.1	4.0	4.0	3.8	4.3	3.9	3.8	3.7	3.7	3.6	3.8
Key West, Fla.	4.4	4.2	4.8	5.0	5.5	4.7	4.7	4.7	5.1	5.4	5.1	5.0	4.9

* Using the nomenclature of Ekholm.

The results of the compilation show that practically all of the pressure falls (katallobars) pass entirely across the United States from the Pacific to the Atlantic; that is to say, the number entering the continent on the Pacific coast is practically the same as that leaving the continent on the Atlantic coast at Eastport, Me. The average number which passes St. Paul, Minn., in the interior is slightly greater than that which enters the continent over the coasts of Washington and Oregon. The number is somewhat larger at northern than at southern stations, and the maximum for any month generally falls in the winter, although there is the suggestion of a secondary maximum in August, which at Portland, Oreg., becomes the primary maximum.

Duration of katallobars.—Along the northern boundary of the United States falling pressure, in a little more than

¹ Defant, A. Die täglichen unperiodischen Druckschwankungen im Gebiete der Vereinigten Staaten von Nordamerika. Meteorol. Ztschr., Braunschweig, November 1916, 33: 503–510. 3 figs.

² "Station pressure" for a Weather Bureau station is the corrected pressure for the station at the altitude of the station.